Assessing community resilience to natural disaster and climate change in Maitara Island, North Maluku-Indonesia

Mohammad Ridwan Lessy¹, Jefry Bemba¹, and Nani Nagu²

¹Marine Science Department, Khairun University, Ternate, 97719, Indonesia

²Civil Department, Khairun University, Ternate, 97719, Indonesia

Abstract. Small Islands face some of the main problems of any coastal area due to climate change and natural disasters. This study aims to analyze the resilience of coastal communities on a small island in terms of disasters and climate change, and to identify the strategies and adaptations that communities have undertaken as anticipatory for disaster and climate change in the future. Qualitative analysis combined with quantitative methods is used in this research to provide a clear estimate of the categories of resilience in each village. The primary data was collected by using interviews and focus discussion group and secondary data acquired through the documentation on related stakeholders. The resilience index provided by the Ministry of Maritime and Fisheries Affairs is used to categorize the resilience scales of villages. The results of this study show that the human aspects and natural resources aspects have high scores in resilience, but disaster and climate change aspects; environmental/infrastructures aspects; and economic aspects should be improved. Furthermore, the community had been taking participation in disaster mitigation.

1 Introduction

Natural disaster and climate change are emerging as major threats to the coastal community who are living largely in small islands and coastal areas [1-2]. Any issues caused by or associated with the potential impacts of natural disaster and climate change will have profound effects on the coastal community. Additionally, the community who relies on natural resources for subsistence and economic activities has been influenced over the last few decades. Therefore, all attention from researchers, environmental activists, and development practitioners has been increasing regarding community resilience [3-6].

As a small island, Maitara is one of the most impacted and vulnerable islands in North Maluku Province-Indonesia. The vulnerability encompassing the recurrence and power of atmosphere hazard and risks inside a region condition had been expanding because of environmental change [7]. Repeating threats from seaside risks, including huge scale, fast moving catastrophes, for example, hurricanes and storm surges had been looked by people in this island. Furthermore, the slow-moving threats, such as dry season, seaside scraped area, and ocean level ascent have given the effect to beach zones. In this manner, these unsafe occasions have adversely affected the people in different degrees [8].

Generally, adaptation and resilience information has concentrated mostly on large-scale global, regional, national level scenarios of disaster and climate change and the recommended international-level policy options

[9]. From observation how communities use their assets in proficient approaches to recoup from the genuine and potential harm from disaster and atmosphere hazards is something imperative to helping individuals get ready for, and bounce back from, ecological and meteorological debacles [10]. This research aims to contribute to community resilience research through application of resilience village models and measuring the degree of resilience in small island community which facing both gradual and sudden changes in disaster and climate. The research also provides the essential information for policymakers in helping communities to avoid or withstand losses from disaster and climate hazards.

1.1 The concept of community resilience

In community resilience studies, the term ‘community’ has been defined variously. It includes the totality of social system interactions, i.e., an effective unit of belonging and identity, and a network of relations that usually within a defined geographical space [11-12]. Another definition is any gathering of people that offer regular interests, relate to each other, have a typical culture, and take an interest in shared exercises [13-14]. Similar interpretations are as a group of people who living within the territorial boundaries of an administrative unit [15], and a place-bound neighbourhood as well as an interest or kinship-based social unit [16].

Meanwhile, Resilience is an enlightening idea, with exact definition and meaning and operationalized

* Corresponding author: mrlessy8375@gmail.com

quantitatively, can be connected to hard frameworks in physical, natural, and hard atmosphere sciences. Ecosystem resilience, ecological resilience, the engineering resilience, and simply resilience are the concepts that used in resilience [17].

The resilience of a system (or community) involves both static and dynamic aspects. On the one hand, the concept of resilience as an inherent condition or position or the result of communities' ability to stay on pressured circumstance [18-21]. Therefore, community resilience, as the idea has continued to develop, there has also been increased recognition of the importance of developing methods and instruments for its assessment [22-23]. It has attracted huge attention due to the increasing number of natural and man-made disasters. On the other hand, the concept of resilience is multi-dimensional and it involves various subjects of different disciplines [24]. For instance, from the engineering side, resilience is the ability to "withstand stress, survive, adapt, and bounce back from a crisis or disaster and rapidly move on" [25]. While, the social aspect state that resilience could be the definition as "the ability of organizations or communities to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways to minimize social disruption and mitigate the effectors of further earthquakes" [26]. In another word, resilience can be defined as the capability of a system or part of the system to absorb and recover from the disaster event [27-28]. Recently, the concept of resilience has been applicable to the engineering domain, which makes it hard to determine a generally accepted definition for resilience engineering [29].

Because of the dynamic interactions of people, community, societies, and the environment, the assessment of community resilience become a complicated process. Therefore, many conceptual frameworks proposed to measure this concept [30-31]. Overall, most of these frameworks put disaster resilience in the same way, in which they all focus on common factors that could reduce vulnerability and increase community resilience. Those factors include economic resources, assets and skills, information and knowledge, support and supportive networks, access to services, and shared community values.

2 Materials and methods

2.1 Study sites

This study focuses on Maitara Island, a small island with an area only 2,8 Km² that located between Ternate Island and Tidore Island, North Maluku-Indonesia. The study site is shown in Fig. 1. Administratively, the island includes in North Tidore district territory of North Maluku Province. Despite it has a limited area, there are four villages on Maitara Island; i.e. Maitara Village, North Maitara Village, Center Maitara Village, and South Maitara Village. Moreover, because more people rely on coastal resources, those villages broadly recognized as fisheries village.

Fig. 1. Study site

Statistical data in 2016 shows that the total population in Maitara Island (4 villages) is 2,317 people with the total of 577 households. In detail, South Maitara Village has the largest population of 779 people and the least is Maitara Village as many as 394 inhabitants. Overall, the growth rate in Maitara Island about 0.5% per year. Based on the ratio of male and female in 2016, it was observed that male dominated three villages in Maitara Island, while the middle Maitara village has more female [32]. Furthermore, from livelihood aspect, most of the male in this island work as fishermen then followed by civil servants and entrepreneurs, while the women being traders and household.

The information collected from the previous survey, explain that each village has experienced different extents of exposure to coastal hazards and have different behavior on toward the disaster. On the other hand, part of the coastal ecosystem including mangrove forest, coral reefs, and seagrass had damaged by natural and anthropogenic activities. This makes the study area as the suitable location for understanding the coastal community resilience.

2.2 Coastal village resilience approach

The paper is based on Coastal Resilience Village Development (CRVD) approach launched by Ministry of Maritime and Fisheries Affair Republic of Indonesia. This approach is referring to Climate Disaster Resilience Village [33]. In this technique, the exposure, sensitivity, and adaptability are three important things used to analyze the assessment of the resilience of natural disaster and climate change. Therefore, this procedure will extend methods that already exist to assess the community resilience and validating the selection of capacity variables externally and internally of community.

Accordingly, in criteria of village resilience in CRDV there are twenty-six capacity selected indicators. Furthermore, this indicator covers five aspects of community resilience, i.e. human development, business development, resource development, environment/infrastructure development, and disaster preparedness [34]. The five aspects are then translated in the concept of CRDV as general variables (fixed) and special variables, as shown in Table 1.

Table 1. Variables, indicators and resilience score in CRDV approach

General Variables	Specific Variables	Indicators	Resilience criteria/score		
			Low	Moderate	High
			1	2	3
human aspects	1. Race and Ethnicity	1. The Pattern of ethnic/racial acculturation in the village	Conflict / competition often occurs	Nothing flashy	Harmonization occurred
		2. Indonesian language skills	The majority of the population cannot understand Indonesian	The majority of the population can only speak Indonesian verbally	The majority of the population can speak Indonesian well and can read and write
	2. Knowledge, Readiness, and Crisis Facing Skills	3. Community Knowledge in recognizing the characteristics of disasters, prevention, handling and post-disaster rehabilitation	The community does not yet have sufficient knowledge of climate change, the phenomenon of disaster, its prevention strategy, and rehabilitation	Some Communities already have knowledge and information about climate change, the characteristics of disaster, prevention, control and rehabilitation	The majority of leaders and communities in the village have a very good and complete knowledge about climate change, symptoms of disaster, prevention strategies and rehabilitation.
		4. Community preparedness in disaster evacuation and post-disaster rehabilitation	The community does not have planning, procedures, and or experience on disaster evacuation and post-disaster rehabilitation	The community has started to develop procedures related to disaster evacuation and post-disaster rehabilitation, but not in written form	The community already has documents or procedures on disaster evacuation, post-disaster rehabilitation, and is known by the people
		5. Community capacity in disaster evacuation and post-disaster rehabilitation	There is no empirical experience experienced by the Community related to disaster evacuation and post-disaster rehabilitation	Communities have empirical experience in evacuation and rehabilitation of disasters, but are still limited and have not involved extensive networks	The community already has a high capacity in disaster evacuation and post-disaster rehabilitation and has involved the role of government and private sector with clear support
	3. Population Density	6. Population density in the village	The density level $\geq$ (exceeds the tolerance limit, exceeding 1500 inhabitants / km ²)	The population spread evenly	Normal density level below (tolerance limit, range 1500 soul / km ²)
	4. Age Composition	7. Proportion of productive and non-productive age population	Proportion of productive age population > non-productive age population	Proportion of productive age population = non-productive age population	Proportion of productive age population < non-productive age population
	5. Education Level of Population	8. The number of people completing junior high school education	Majority of residents have not completed junior high school education	Some residents have completed junior high school education	The majority of the population has completed junior high school education
	6. Counseling	9. The Existence of counseling on disaster preparedness and climate change	No extension activities exist on disaster preparedness and climate change	Already began to see extension activities on disaster preparedness and climate change but not yet socialized well	There are extension activities on disaster preparedness and climate change and are well socialized
		10. The ability of the government to maintain the attitude of togetherness	The government is unable to coordinate with local leaders to maintain a system of community togetherness	The government has started to build relationships with local leaders to maintain a system of community togetherness	The government has been able to coordinate with local leaders to maintain the system of togetherness in the community simultaneously
Economic Aspects	7. Occupation	11. The Proportion of population working in agriculture and fisheries sector	The Proportion of population working in agriculture and fisheries $\geq 50\%$	Population livelihoods vary	The Proportion of people working in the agriculture and fishery sector <50%
		12. Number of residents who have additional /side jobs	Number of residents who have additional /side jobs <50%	The average has side jobs	Number of residents who have additional /side jobs $\geq 50\%$

		13. The number of people who have no income in the last 6 months	Number of people who have no income in the last 6 months $\geq 50\%$	Number of people who have no income in the last 6 months 10 - 50%	The number of people who have no income in the last 6 months $<10\%$
		14. The diversity of community economic enterprises	The population has only one source of business and it is difficult to develop	Residents have some business options with pretty good developments	The population has a variety of businesses and high creativity in the business development
	8. Business management by the village	15. The frequency of out-of-village institutions that provide assistance to the village	There has never been an institution outside the village providing business capital assistance to the village	The village has only one business capital aid in the past year	The village received more business capital assistance from various parties from outside the village in the past year
		16. Management of business assets owned by the village	There are no business assets owned by the village	There are business assets owned by the village but only managed by individuals	There are business assets owned by well-managed villages and conducted in groups in the village
		17. The existence of community economic business group	No community economic group	There are groups of people's economic enterprises but not developing	There are groups of people's economic enterprises and well developed
	9. Poverty	18. Number of households targeted by poverty reduction program	number of households targeted poverty reduction program $\geq 50\%$	number of households targeted by poverty reduction program 30 - 50%	number of households targeted by poverty reduction program $<30\%$
	10. Economic Facilities	19. The existence of financial institutions /cooperatives / and the like	There is no	There is but has not gone as expected	There and still goes well
	11. Entrepreneurship	20. The frequency of community entrepreneurship capacity building activities	There has never been entrepreneurship training in the village in the past year	There has been entrepreneurship training in the village in the past year	There was once entrepreneurship training in the village and there was a new alternative job emerging
Natural Resources Aspects	12. The condition of Coastal Ecosystem	21. Condition of mangrove vegetation (coastal vegetation) / Coral reefs / Seagrasses in coastal villages	no mangrove vegetation (coastal vegetation) / Coral reefs / seagrasses in small / low coastal villages	There are mangrove vegetation (coastal vegetation) / Coral reefs / Seagrasses in coastal villages but under faulty conditions	There is mangrove / mangrove vegetation (coastal vegetation) / Seagrass in large coastal villages / with good conditions
		22. Trends in the condition of mangrove vegetation (coastal vegetation) / Coral reefs / Seagrasses in coastal villages last 5 years	The condition of mangrove vegetation (coastal vegetation) / Coral reef / Seagrass in coastal villages last 3 years is worse	The condition of mangrove vegetation (coastal vegetation) / Coral reef / Seagrass in coastal villages of the last 3 years is the same	The condition of mangrove vegetation (coastal vegetation) / Coral reef / Seagrass in coastal villages last 3 years is better
		23. Types of natural resources cultivated in the village	Focus more on non-recoverable resources such as mine and no initiation of recovery of natural and environmental conditions so vulnerable to disasters	The types of natural resources are diverse and there are already conservation and control utilization efforts	Natural resources are diverse and supported by supervision over management, there are institutions that monitor the condition of natural resources
	13. Resource Maintenance	24. Planting / treatment / destruction of mangroves	There is no mangrove planting and treatment	There is mangrove planting but no mangrove treatment	The planting and maintenance of mangroves are well coordinated
		25. The existence of coastal ecosystem rehabilitation activities (Mangrove /coral reef /seagrass)	The absence of coastal ecosystem rehabilitation activities (Mangrove /coral reef /seagrass)	The existence of coastal ecosystem rehabilitation activities (Mangrove /coral reef /seagrass) and not run effectively	The existence of coastal ecosystem rehabilitation activities (Mangrove /coral reef /seagrass) and run effectively
		26. The existence of coastal ecosystem conservation activities (Mangrove /coral reef /seagrass)	The absence of coastal ecosystem conservation activities (Mangrove /coral reef /seagrass) and not run effectively	The existence of coastal ecosystem conservation activities (Mangrove /coral reef /seagrass) and not run effectively	The existence of coastal ecosystem conservation activities (Mangrove /coral reef /seagrass) and run effectively

	Coastal resources management group	27. The existence of coastal ecosystem management group (coral reef /mangrove, etc.)	no management of coral reef /mangrove	There is a group of coral reef mangrove management but it is not going well	There is a group of coral reef /mangrove management and run effectively
		28. The existence of monitoring activity of coastal ecosystem condition	no monitoring /monitoring of coastal ecosystem conditions has ever been undertaken	Once conducted monitoring activities / monitoring the condition of coastal ecosystems but the community is not involved	A monitoring and monitoring of coastal ecosystems has been conducted and involved many parties
	Availability of coastal resources information	29. There is information about the potential of coastal resources	there are no means of information on the potential of coastal resources	There are facilities that provide information on the potential of coastal resources but the conditions are unfavorable and unreadable	There are facilities that provide information on the potential of coastal resources that are complete and easy to read
		30. Access/distance to natural resources – the economy	Difficult, damaged, and no public infrastructure and means of transportation	Still passable vehicles with infrastructure already built but no public transportation service	Transportation facilities and infrastructure are easy, there is an infrastructure that supports transportation services, and there are regular, safe, and affordable public transport services
Environmental and Infrastructure Aspects	16. Availability of Facilities	31. Road conditions	Road access to the village is unpaved / concrete	Road access to the village is only concrete	Th access road to paved / concrete village
		32. Electricity availability	Electricity customers> 80%	Electricity customers 50 - 80%	Electricity customers <50%
	17. The Condition of Residential Buildings	33. Condition of residential building (permanent / semi-permanent)	Percentage of semi-permanent house> Percentage of permanent house	Percentage of semi-permanent house = percentage of permanent house	Percentage of semi-permanent house <percentage of permanent house
		34. Percentage of houses across the coastline	Percentage of houses across the coastal line> 70%	Percentage of trans-shore houses with coastline ranges from 50 - 70%	Percentage of transshipment homes with shoreline <50%
		35. Percentage of houses inhabited on a hillside location	Percentage of houses inhabited on hillside> 70%	The percentage of houses inhabited on hillside ranges from 50-70%	Percentage of houses in the hill location <50%
	18. Source of Clean Water	36. Number of sources of clean water used by residents (such as springs, well water, etc.)	There is only one type of source of clean water used by residents	Number and types of water sources used by residents> 1	Number and types of sources of clean water used by residents> 2
	19. Pollution	37. Presence of contamination	Almost all areas are polluted	Some areas are polluted	No polluted area
	20. Health Service	38. Number of health service point in the village	There is no health service point in the village	There is only one health service point in one village	Number of health service point in each village> 1
		39. Number of medical personnel in the village	There are no medical personnel, midwives or health personnel	There are medical personnel in the village (there is a doctor or health officer or village midwife)	The number of medical personnel is sufficient (there is at least 1 doctor, village midwife or health officer)
	21. Government Responsibility	40. The government's responsibility for development planning, both physical and non-physical	The government does not yet have any physical and non-physical development plans	The government already has a development plan that is both physical and non-physical but has not been implemented properly	The government already has a development plan that is both physical and non-physical and has been implemented well
Disaster Preparedness and Climate Change Aspects	22. Early Warning System	41. The existence of an early warning system for disaster in the village	There is no early warning system for disaster in the village	There has been an early warning system but has not yet attempted a simulation of disaster evacuation in the village	There is already an early warning system and a simulated disaster evacuation effort has been done in the village

		42. Whether or not local wisdom is being used for disaster risk reduction efforts	No local wisdom is found in the community	There is local wisdom held by the community but has not been effective yet	There is local wisdom adopted in the community and effectively utilized for disaster risk reduction efforts
	23. Physical Building	43. The presence or absence of coastal protection structures	There is no coastal protection structure as a disaster prevention effort	There is already a coastal protective structure but in a damaged condition	There is already a coastal protection structure with good conditions
	24. Availability of Facilities	44. The presence or absence of disaster information facilities	There are no means of disaster information at all	There is already a disaster information tool but it is not working	There is already a means of disaster information and functioning well
		45. Availability of shelter shelters	There are no shelters available for disaster evacuation	A shelter is available as a place to evacuate the disaster but the condition is not good	A shelter is available in good condition as a disaster evacuation site
		46. The existence of the village's strategic reserves is facing a disaster	The absence of the village's strategic reserves faced a disaster	The existence of the village's strategic reserves faced a disaster but did not work	The existence of the village's strategic reserves faces disaster and runs effectively
		47. Availability of disaster evacuation routes	No disaster evacuation path is available	A disaster evacuation route is available but path conditions are inadequate	A disaster evacuation route is available that is easily accessible to disaster victims
		48. The presence of disaster prepared groups	no disaster prepared groups	The presence of disaster prepared groups but not running	The existence of disaster preparedness groups and run effectively
	25. The Responsibility of the Government	49. Government's responsibility for anticipating the occurrence of disasters and climate change	The government has no plans and efforts to anticipate the occurrence of disasters and climate change	The government has started to develop plans and efforts to anticipate the occurrence of disasters and climate change	The government already has plans and efforts to anticipate the occurrence of disasters and climate change supported by adequate equipment and equipment
	26. Disaster-related regulations	50. The presence or absence of village-level regulations related to disaster preparedness	the absence of regulations at the village level that are in tune with disaster preparedness	The existence of regulations at the village level are related to disaster alert but not running	The existence of regulations at the village level are related to disaster preparedness and has been effective

2.3 Data collection and analysis

$$RRI = a + b + c + d + e \quad (1)$$

This research adopted qualitative research with a quantitative approach where the data collecting process and analysis will conduct in qualitative application but the determination of the level of coastal village resilience will use the quantitative procedure.

First stage in the research is the data collection stage. In this step, all the information will gather. These activities include both in-depth interviews which conducted by a stakeholder analysis and continued by field survey and questionnaire. The purposive sampling was used in the questionnaire survey where the respondents come from all strata in communities that varied on their age, gender, occupation, education level, and status. furthermore, Focus Group Discussions (FGD) held in each village to complete the data. FGD involves all stakeholders and communities. It was conducted to supplement the missing information and validate the data from the questionnaire results. On the second stage, we determine the coastal village resilience using formula;

Where;

RI = Relative Resilience index

a = Human aspects score (30 max)

b = economic aspects score (30 max)

c = Natural Resources Aspects score (30 max)

d = Environmental and Infrastructure Aspects (30 max)

e = Disaster Preparedness and Climate Change Aspects (30 max)

At the last stage, all information that had been collected will be compiled to determine the criteria of coastal village resilience. The minimum score for each aspect is 10 and the maximum is 30. Furthermore, all score will calculation and break down to categorize into low (50 – 83), moderate (84-116), and high (117-150). The overall process to assess the coastal village resilience refers to the flowchart shown in Fig. 2.

Fig. 2. Flowchart for assessment of coastal resilience

3 Result and discuss

3.1 A community perspective on disasters and climate change in study sites

Disaster risk reduction efforts place the citizens who live in disaster-prone areas as the main actors, as participating subjects rather than objects, and will be more sustainable and efficient. Therefore, the people living in the region should have a good understanding of the potential threat of disasters that will occur and befall them. Communities that have reached the best level of resilience to disasters will be able to maintain their structure and function to a certain extent when exposed by disasters.

Results of this study show that around 85% of respondents said that they understand the incidence of disasters that will occur and hit their village area. Respondents also clearly explained every event of a disaster that ever hit the territory of the island Maitara. One of worse disasters is the Gamalama volcanic eruption in 1980. Gamalama is a volcano mountain located in Ternate Island. The eruption resulted in volcanic ash rain which is quite detrimental. The eruption of Gamalama at the time is last for approximately one month. As a consequent, most of Ternate's people evacuate to Tidore Island. Moreover, the volcanic ash also reached the area of Maitara Island so that the people of Maitara Island also took refuge to Tidore Island.

The respondents also know clearly about climate change and its threats that have begun last few years. This is marked by changes in seasons between eastern and western seasons. Usually, the fishermen can predict the seasons but in the last few years, the prediction they set has undergone many shifts with uncertain rainfall, changes in wind patterns, greater frequency and wind intensity, wave and wave intensity, and coastal erosion. These results confirm the occurrence of extreme weather such as increased rainfall [35], wind intensity [36], waves and currents [37], drastic coastal erosion is the impact of climate change. Those impacts primarily have been faced by people in all four villages in Maitara Island.

Additionally, from the fisheries aspects, the fishermen observe that the fish colony is recently not found at sea surface but in deeper water. This condition shows that there has been shifting in the fishing ground area. On the other side, from FGD results, the respondents stated that rising of temperature correlates with the fish availability. Therefore, it could be express that rising air temperatures make the surface of the sea water getting hotter and the fishing ground has moved. Moreover, these circumstances make the fish look for cooler temperatures at deeper locations. These phenomena show that the climate change also gives the impact to fisheries sectors [38-39]. Consequently, the fisherman will difficult to catch the fish and will give the impact to others aspects.

On the other hand, the people understand that the projection of sea level rise will give the effects to small island. The Increase of erosion on coastal areas, the loss of relatively limited productive land, increase the risk of storms, seawater intrusion and disrupts of clean water supply on the island are the examples of impacts that occur in the future. This phenomenon has influenced all sectors that are vulnerable to the effects of climate change. For instance, the limitation of groundwater or freshwater resources [40-42] the damage of natural resources [43] and future projection shows that the threat of food security will occur. As a prediction, the people who live in the next ten years will face the huge problem in economic and socio-cultural life. Therefore, without serious efforts conducted by all stakeholders, the impact of climate change will further increase socio-economic problems in the community.

3.2 The resilience of coastal villages

The collaboration of resistance, capacity for recovery and self-organization, and the ability to adapt to new conditions by the community could be explained as resilience to disaster and climate change of a community. Therefore, the important step in community resilience analysis is Identifying pre-disaster and climate change resilience indicators [44].

This study gathered a data of representative resilience capacity variables that were previously discussed with result shows that the level of community resilience in study area indicates that human aspect and natural resource aspect is quite good with average score at 10-15, while other aspects are still weak (shown in Fig. 3).

3.2.1 Human aspects

The human aspect is the first point due to the importance of human roles in climate change adaptation and mitigation. Some important things studied in the human aspect include; race/ ethnicity, knowledge, gender, population density, age, and disaster education. It also includes any other advantages people have, including disaster experiences, which give them the ability to cope with, adapt to, and recover from disasters [45].

Fig. 3. Resilience aspects in Maitara Island

The study result shows, in terms of ethnic aspect that people who occupy in Maitara island generally has a variety. The residents dominated by ethnic Tidore and slightly mixed with other ethnic groups (Ternate, Makian, Kayoa, and others). This ethnic diversity has very maintained the pattern of harmonization in society. Therefore, a good acculturation pattern builds among residents. In case of conflict, for example, will soon be resolved quickly by communication with each other.

On the other hand, the ability of people to communicate using both Indonesian and regional languages is very well. They use those languages for both oral and written.

The next aspect is knowledge and ability of people to face the disaster and climate change. To build the community resilience, the knowledge and skill of individuals on hazards, hazard history, and hazard risk can be an important resource [45]. This aspect shows that the majority of leaders and communities in all villages have a good knowledge of climate change, the symptoms of disaster, prevention strategies and rehabilitation action.

Another thing that influences the human aspect criteria is the population number and the ratio of productive population. The population density in the study site is evenly distributed and does not exceed the tolerance limit or exceeds 1500 inhabitants / km². In addition, the proportion of the productive age population is greater than the non-productive age population.

However, there are some weakness variables in the human aspect. Skills and knowledge to adapt to and mitigate disasters and climate change have not been accommodated in village regulations. Thus, the community in acting still individually. In addition, standard operating procedures (SOPs), evacuation plans and other disaster-related issues do not exist. This has an impact on the community's ability to cope with disasters. As a result, the human aspect of community resilience in the study area state in high scale.

3.2.2 Economic aspects

The economic aspect is another important aspect involves financial resources that the community used to gain their livelihoods. It includes savings, income, investments, and assets management. Accordingly, the contribution to building community resilience from this

aspect is straightforward in the meaning that it improves the ability and capacity of individuals, groups, and communities to assimilate disaster effects and speed up the recovery action [45].

As a small island and coastal area, the proportion of people who work in the agriculture and fishery sector more than 50%, which includes fishermen, farmers, fish traders, and gardener. Based on the resulting study, the number of residents who have side jobs is less than 50%. Meanwhile, the proportion of the population that has no income in the last 6 months ranges from 10% to 50%. They are students, retired and unemployment. As a result, around 50% people income less than the regional minimum standard and the poverty about 30 - 50%.

Furthermore, from the aspect of business management, the training frequency from other institutions that provide assistance to businesspersons in terms of economic development is quite low. Moreover, there is no asset to the village managed by the village government and the communities rely on one livelihood. It makes the community resilience to disaster and climate change in the economic aspect in low level.

3.2.3 Natural resources aspects

Undoubtedly natural resources have an important role in resilience to disaster and climate change. The availability of natural resources provides the basic need by humans such as water, minerals and oil, land and the ecosystems that maintain clean water, air, and a stable climate [45].

The natural resources aspects of this study is focusing on coastal resources (mangroves, seagrass, and coral reefs). The conditions, maintenance, management by communities, and provision of information on resources are part of Coastal ecosystem data. The study result shows that the condition of the coastal ecosystem that includes mangrove forest, coral reef ecosystem, and seagrass ecosystem in the last one decade is in the various categories.

The distribution of coral reef in this study site only in Eastern part (Maitara Village), Northern part (North Maitara Village), and in The Western part (South Maitara Village). Overall, the coral reef covers approximately 17.55 Ha. Unfortunately, the coral condition in the study area has been damaged between 21.40% - 41.80% due to anthropogenic activities (bombing and destructive fishing gears) [46].

The mangrove species composition was found based on inventory data in the field consisting of 4 mangrove species (*Rhizophora apiculata*, *Sonneratia alba*, *Sonneratia caseolaris*, and *Avicennia alba*). In 2012, the mangrove area in Maitara island covered around 6.0 Ha [46] but it reduces 1.09 Ha to 4.91 Ha in 2017 [47].

The existence of mangrove forest in the study area has been decreased due to the use of mangrove by the community and land use change. In 2017, the total number of mangrove tree as many as 361 trees compare to 523 trees in 2012.

Meanwhile, the study location found about 8 types of seagrasses with an area of 25.56 Ha. The percentage of cover ranged from 46.67% to 57.77% [48]. Overall this

data informs that category of seagrass in the study area in the moderate category.

Nevertheless, in the last two years, the awareness of the community and village government in term of natural resources management has been improved due to the workshop, training and community services conducted by the local government, university and NGO. In the workshop and training, several activities had been done such as mangroves planting, coral and seagrass transplantation. Furthermore, in community services, the community learn how the importance of natural resources in their life and their responsibility to maintain and conserve it. Thus moderate level can be given a category in this aspect.

3.2.4 Environmental / infrastructure aspects

Physical capital refers to the built environment and infrastructure aspects. It is one of the essential aspects in order to build the capacity of the community to cope with disasters and climate change [45]. In this study, environmental and infrastructure emphasize on the road, bridge, and embankments, as well as basic facilities (water, electricity, and health). All of them are essential for proper functioning of the community, especially during evacuation time.

As a small island, the road access in Maitara Island was limited and in bad condition. As a consequence, the people rely on marine transportation (boat or speedboat) as a way to connect to another island.

All infrastructure built near the coastal line in the study area are very risky. The government had been built beach embankment to protect the coastal line, but it was not efficient because this infrastructure builds just in the certain area and had been damaged when high wave occur. As a coastal community, all people build their houses located near the coastline with bricks as the main construction material. The location of the houses will have an impact on the damage to the building if disaster and sea level rise occurs.

Basic facilities needed by the community (water, electricity, and health) in study area are very limited. The shallow well is a source of drinking water. Accordingly, water scarcity will be the problem in the future. On the other hand, the electricity had been provided by Electricity Company but it generated by fossil fuel. As a consequence, it is less sustainable. Meanwhile, lack of health facilities and medical personnel that available in study area increases the vulnerability in health aspect. Whereas the facilities are important to ensure that people have resources and support arrangement during emergencies when disasters and climate change occurs.

3.2.5 Disaster preparedness and climate change aspects

The last aspect, preparedness and climate change aspects have an influential role in the community. This aspect includes an early warning system, shelter facilities, government capacity, and regulations. As preparedness

steps, early warning system and shelter facilities should be available. Unfortunately, those facilities are limited in the study area. The absence of early warning system, disaster information facilities, evacuation routes and strategic reserves to face the disaster, and Standard Operation and Procedure (SOP) or contingency plan put have put this aspect's poin in the lower score. On the contrary, there are several points that have positive impacts such as the efforts made by the government, NGO, and the Community in facing disaster risks, for example, maintaining coastal ecosystems, building water reservoirs and coastal protection structures

4 Conclusions

One of the most discussed issues by many experts in recent years is the impact of climate change event. Small islands are being highly vulnerable to the negative consequences of disasters and climate change. In response, there is a strong need for coastal communities particularly in the small islands to be cooped-up, adopted and bounced back after an extreme event.

According to this research, community resilience in Maitara Island is at moderate level. This level is resulted from lack of indicators in all aspects of study areas as a key variable. The study has brought deep insights on local realities of unique community personalities and culture that makes differences in the levels of individual's resilience, especially in small island coastal area. Through understanding the community mindset and enhancing their capacity, the adaptation process will improve. For this reason, planned adaptation interventions and support from all stakeholders are needed to increase the people's ability to plan, their right to choose, and the right to be able to make an informed choice. As a consequence, it will help to bridge the gap between spatial planning and disaster resilience buildings, especially in Disaster Risk Reduction (DRR) initiatives in for the future.

References

1. Lam, N.S.N.; Arenas, H.; Brito, P.; Liu, K.B. J. Coast. Res. 2014, 70, 473–478.
2. Lloyd, M.G.; Peel, D.; Duck, R.W. *Land Use Policy* 2013, 30, 925–933.
3. Abramson, D.M.; Grattan, L.M.; Mayer, B.; Colten, C.E.; Arosemena, F.A.; Bedimo-Rung, A.; Lichtveld, M. J. Behav. Health Serv. Res. 2015, 42, 42–57. [CrossRef] [PubMed]
4. Skerratt, S. J. Rural Stud. 2013, 31, 36–46. [CrossRef].
5. Skerratt, S.; Steiner, A. Local Econ. 2013, 28, 320–338. [CrossRef]
6. Steiner, A.; Markantoni, M. Community Dev. J. 2014, 49, 407–425. [CrossRef]
7. Tabai, I. Marine Policy. 1994.18(2).183-185
8. Regional Disaster Management Agency of North Maluku Province. *North Maluku Disaster Risk Study in 2016-2020 (in Indonesia: Kajian Risiko Bencana Maluku Utara 2016-2020)*. 2016.

9. Osbahr, H. Background Paper for UNDP Human Development Report 2007/2008; UNDP: New York, NY, USA, 2008.
10. Bergstrand, K.; Mayer, B.; Brumback, B.; Zhang, Y. Soc. Indic. Res. 2015, 122, 391–409. [CrossRef].
11. Wilson, G.A. *Community Resilience and Environmental Transitions*; Routledge: London, UK; New York, NY, USA, 2012.
12. Wilson, G.A. Geoforum 2012, 43, 1218–1231. [CrossRef]
13. Fellin, P. *The Community and the Social Worker*; F.E. Peacock: New York, NY, USA, 1995.
14. Ungar, M. Child. Youth Serv. Rev. 2011, 33, 1742–1748. [CrossRef]
15. Allen, M.K. Disasters 2006, 30, 81–101. [CrossRef] [PubMed]
16. Murphy, B.L. Nat. Hazards 2007, 41, 297–315. [CrossRef]
17. Kais, S.M, and Islam, Int. J. Environ. Res. Public Health 2016, 13, 1211; doi:10.3390/ijerph13121211. www.mdpi.com/journal/ijerph
18. Rose, A. Disaster Prev. Manag. 2004, 13, 307–314. [CrossRef]
19. Cutter, S.L.; Barnes, L.; Berry, M.; Burton, C.; Evans, E.; Tate, E.; Webb, J. Glob. Environ. Chang. 2008, 18, 598–606. [CrossRef]
20. Reid, R.; Botterill, L.C. Aust. J. Public Adm. 2013, 72, 31–40. [CrossRef]
21. Rose, A. Environ. Hazards 2007, 7, 383–398. [CrossRef]
22. Cohen, O., Bolotin, A., Lahad, M., Goldberg, A., Aharonson-Daniel, L. Ecol.Indic. 2016. 66, 497–502.
23. Cutter, S.L. Nat. Hazards. 2016.80,741–758
24. G. P. Cimellaro, Renschler, C., Reinhorn, A. M., and Arendt, L., Journal of Structural Engineering, ASCE, 2016.
25. I. Wagner, P. Breil, Ecohydrology & Hydrobiology 13. 2013, pp. 113-134.
26. M. Bruneau, S. E. Chang, R. T. Eguchi, G. C. Lee, T. D. O'Rourke, A. M. Reinhorn, et al., Earthquake Spectra 19 .2003. pp. 733 -752.
27. B. Allenby, J. Fink, Science 309. 2005. pp. 1034-1036.
28. Klein, R.J.T., Nicholls, R. J., & Thomalla, F. Environmental Hazards, 5, 2003. 35-45.
29. S. Hosseini, K. Barker, J. E. Ramirez-Marquez, Engineering & System Safety 145. 2016. pp. 47-61.
30. Adger, W.C. Progress in Human Geography, 24(3). 2000, 347-364.
31. Buckle, P. (2006). Assessing social resilience. In D. Paton & D. Johnston. Disaster resilience: *An integrated approach* (pp.88-103). Springfield, IL: Charles C. Thomas.
32. Statistics of Tidore Archipelago Municipality. *Tidore Kepulauan in Figures*. 2017. ISSN. 2503-135X
33. Directorate of Coastal and Oceanic Affairs. *Guide to Assessment of Coastal Village Resilience Condition* (in Indonesia: *Panduan Penilaian Kondisi Ketangguhan Desa Pesisir*).
34. Ambariyanto and Denny N.S. Riptek Vol. 6, No.II, Tahun 2012, p.: 29 – 38.
35. Sohoulade Djebou, D. C., and Singh, V. P. Int. J. Climatol., 36: 2016.3588–3606. doi:10.1002/joc.4578
36. Pryor rand, Renewable and Sustainable Energy Reviews Volume 14, Issue 1, January 2010, Pages 430-437. <https://doi.org/10.1016/j.rser.2009.07.028>*Get rights and content*
37. D.E. Reeve, Y. Chen, S. Pan, V. Magar, D.J. Simmonds, A. Zacharioudaki, Renewable Energy, Volume 36, Issue 9, 2011, Pages 2404-2413, ISSN 0960-1481, <https://doi.org/10.1016/j.renene.2011.02.020>. (<http://www.sciencedirect.com/science/article/pii/S096014811100111X>)
38. Keith, B. Journal of Marine Systems, Volume 79, Issues 3–4, 2010, Pages 389-402, ISSN 0924-7963, <https://doi.org/10.1016/j.jmarsys.2008.12.015>. (<http://www.sciencedirect.com/science/article/pii/S0924796309000931>)
39. Marie-Caroline Badjeck, Edward H. Allison, Ashley S. Halls, Nicholas K. Dulvy. Marine Policy, Volume 34, Issue 3, 2010, Pages 375-383, ISSN 0308-597X, <https://doi.org/10.1016/j.marpol.2009.08.007>. (<http://www.sciencedirect.com/science/article/pii/S0308597X09001237>)
40. Pao-Shan Yu, Tao-Chang Yang, Chih-Kang Wu. J of Hydrology, Volume 260, Issues 1–4, 2002, Pages 161-175, ISSN 0022-1694, [https://doi.org/10.1016/S0022-1694\(01\)00614-X](https://doi.org/10.1016/S0022-1694(01)00614-X). <http://www.sciencedirect.com/science/article/pii/S002216940100614X>)
41. Yang Nan, Men Bao-hui, Lin Chun-Kun, Procedia Engineering, Volume 24, 2011, Pages 643-648, ISSN 1877-7058, <https://doi.org/10.1016/j.proeng.2011.11.2710>. (<http://www.sciencedirect.com/science/article/pii/S1877705811055627>)
42. Laxmi Prasad Devkota, Dhiraj Raj Gyawali, Journal of Hydrology: Regional Studies, Volume 4, Part B, 2015, Pages 502-515, ISSN 2214-5818, <https://doi.org/10.1016/j.ejrh.2015.06.023>. (<http://www.sciencedirect.com/science/article/pii/S2214581815000889>)
43. University of Hawai'i at Mānoa Sea Grant College Program. Climate Change Impacts in Hawai'i - *A summary of climate change and its impacts to Hawai'i's ecosystem and communities*. June 2014. UNIHI-SEAGRANT-TT-12-04
44. Cutter, S.L.; Barnes, L.; Berry, M.; Burton, C.; Evans, E.; Tate, E.; Webb, J. Glob. Environ. Chang. A Hum. Policy Dimens. 2008,18, 598–606. [CrossRef]
45. J. S. Mayunga A draft working paper prepared for the summer academy for social vulnerability and resilience building, 22 – 28 July 2007, Munich, Germany.

https://www.ucursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf

46. Indonesian Institute of Science. *Ternate, Tidore and the Surrounding Coastal Ecosystem, North Maluku* (in Indonesia: *Ekosistem pesisir Ternate, Tidore dan Sekitarnya, Provinsi Maluku Utara*). Editor: Giyanto. P2O-LIPI Jakarta 2012.
47. Nebuchadnezzar Akbar, Nasir Haya, Abdurrachman Baksir, Zulhan Arifin Harahap, Irmalita Tahir, Yunita Ramili, Raismin Kotta. Depik Volume 6, Number 2, Page 167-181, August 2017. ISSN: 2089-7790, e-ISSN: 2502-6194 <http://jurnal.unsyiah.ac.id/depik>
48. Patty, S.I. Jurnal Ilmiah Platax Vol. 4:(1), Januari 2016 ISSN: 2302-3589. <http://ejournal.unsrat.ac.id/index.php/platax>